

WHAT IS CLAIMED IS:

1        1. A method of treating a liquid slurry of comminuted cellulosic fibrous material in a  
2 substantially vertical vessel having an internal surface, comprising:

3                (a) introducing the slurry into the vessel so that the slurry moves substantially  
4 downwardly in the vessel in a column; and

5                (b) at a plurality of vertically spaced locations in the vessel temporarily relieving  
6 compressive forces within the column and the normal forces on the internal surface of the  
7 vessel so that friction between the comminuted material and the vessel internal surface is  
8 temporarily decreased, or substantially eliminated, providing more uniform flow of the  
9 material in the vessel.

1        2. A method as recited in claim 1 wherein (b) is practiced to temporarily reduce the  
2 friction by at least 20% for a slurry ~~with a consistency between about 8-20%~~.

1        3. A method as recited in claim 1 wherein (b) is practiced by providing a plurality of  
2 vertically spaced compression-relieving surface manifestations on the internal surface of  
3 the vessel.

1        4. A method as recited in claim 3 wherein (b) is further practiced by providing at  
2 least one substantially continuous annular element having an inner surface that protrudes  
3 into the vessel from the internal surface a greater distance at a lower portion thereof than  
4 at a higher portion thereof.

1        5. A method as recited in claim 4 wherein (b) is further practiced by providing a  
2 curved inner surface.

1        6. A method as recited in claim 4 wherein (b) is further practiced by providing a  
2 sloped inner surface having an angle with respect to the vertical of between about 5-70°.

1        7. A method as recited in claim 3 wherein (b) is further practiced by vertically  
2 spacing at least some manifestations between about 1-12 feet, and providing the

3 manifestations so that the maximum radial spacing thereof from the internal surface is  
4 between about 1-12 inches.

1 8. A method as recited in claim 3 wherein (b) is further practiced by providing at  
2 least one surface manifestation with an inner surface which contacts the slurry column of a  
3 material having low friction properties substantially the same as polytetrafluoroethylene.

1 9. A method as recited in claim 3 further comprising (c) cooking the material of the  
2 slurry in the vessel at a temperature above 90°C with a cooking liquid.

1 10. A method as recited in claim 9 wherein (c) is practiced by cooking the material  
2 with kraft cooking liquor at a temperature above 100°C, while it has a consistency of  
3 between about 8-20%.

1 11. A substantially vertical vessel having an internal surface and comprising:  
2 a plurality of vertically spaced sets of circumferentially discontinuous protrusions  
3 extending inwardly from said internal surface a maximum distance of about 2-12 inches;  
4 an inlet at or near a top portion of said vessel; and  
5 an outlet at or near a bottom portion of said vessel.

1 12. A vessel as recited in claim 11 wherein said protrusions are arcuate in cross-  
2 section.

1 13. A vessel as recited in claim 11 wherein said protrusions have a substantially  
2 isosceles triangular cross section with an apex angle of between about 10-175°.

1 14. A vessel as recited in claim 11 wherein said protrusions have a substantially  
2 rectangular cross-section.

1 15. A vessel as recited in claim 11 wherein said protrusions have a height of  
2 between about 1-3 feet, and a vertical spacing between at least two sets of between about  
3 1-12 feet.

1        16. A vessel as recited in claim 15 wherein at least two sets of protrusions  
2 vertically spaced between about 1-12 feet have the protrusions thereof circumferentially  
3 offset from one set to the next.

1        17. A vessel as recited in claim 11 wherein the protrusions are circumferentially  
2 spaced from each other between about 5-30°, and an arcuate distance of between about  
3 1-10 feet.

1        18. A method of treating a liquid slurry of comminuted cellulosic fibrous material in  
2 a substantially vertical vessel having an internal surface, comprising:

3            (a) introducing the slurry into the vessel so that the slurry moves substantially  
4 downwardly in the vessel in a column; and  
5            (b) at a plurality of vertically spaced locations in the vessel, causing the slurry to flow  
6 over surface manifestations which extend into the vessel a maximum distance of between  
7 about 1-12 inches.

1        19. A method as recited in claim 18 wherein (b) is further practiced by providing a  
2 plurality of circumferentially discontinuous protrusions at each of a plurality of different  
3 levels within the vessel.

1        20. A method as recited in claim 3 wherein (b) is further practiced by providing a  
2 plurality of circumferentially discontinuous protrusions at each of a plurality of different  
3 levels within the vessel.

1        21. A method as recited in claim 18 wherein (b) is further practiced by providing at  
2 least one substantially continuous annular element having an inner surface that protrudes  
3 into the vessel from the internal surface a greater distance at a lower portion thereof than  
4 at a higher portion thereof, and (a) is further practiced by introducing a slurry having a  
5 consistency between about 8-20%.

1        22. A substantially vertical vessel having an internal surface, and comprising:  
2            an inlet at or adjacent a top portion of said vessel;

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3       an outlet at or adjacent a bottom portion of said vessel, and  
4       at least one substantially continuous annular protrusion connected to said internal  
5       surface and in a substantially horizontal plane, and having a maximum spacing from said  
6       internal surface of between about 1-12 inches, said protrusion having a cross-section  
7       selected from the group consisting essentially of right, isosceles, or scalene triangular,  
8       arcuate, and rectangular.

1       23. A vessel as recited in claim 22 wherein said protrusion has a substantially  
2       isosceles triangular cross-section with an apex angle between about 10-175°.

1       24. A vessel as recited in claim 22 further comprising a plurality of said protrusions,  
2       vertically spaced from each other between about 1-12 feet, and each having a height of  
3       between about 1-3 feet.

2       25. A vessel as recited in claim 22 wherein said protrusion is arcuate in cross-  
3       section with a radius of curvature equal to or greater than its height.

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